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ABSTRACT

This report presents current estimates and projections to 1990 for Delaware population and higher education enrollment. The population estimates and projections are tabulated by age and sex for the total population of the State and by single years of age for the population of college age. The enrollment estimates and projections are tabulated by institution for member institutions of the Delaware Higher Education Aid Advisory Commission. The text of the report contains an introduction, a section on methods and assumptions, and a section on limitations. The last section is followed by a series of tables containing population and enrollment estimates and projections. (Author)

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Prepared for
The Delaware Higher Educational
Aid Advisory Commission

**DELAWARE POPULATION AND HIGHER
EDUCATION ENROLLMENT: CURRENT
ESTIMATES AND PROJECTIONS TO 1990**

by
Norfleet W. Rives, Jr.

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Division of Urban Affairs
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September 1973

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Division of Urban Affairs
University of Delaware

September 1973

FOREWORD

This report was prepared at the Division of Urban Affairs, University of Delaware, under contract with the Delaware Higher Educational Aid Advisory Commission. Full financial support was made possible by a grant awarded under Title I of the Higher Education Facilities Act, as amended, from the Division of Academic Facilities of the United States Office of Education. The research was funded from Fiscal Year 1972 and completed in September 1973.

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Norfleet W. Rives, Jr.

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INTRODUCTION

Information concerning the future course of population growth is essential to the formation of rational plans for economic and social development. An increasing number of civil servants engaged in the planning function have begun to realize that responsible public programming depends upon an adequate knowledge of the demographic situation. Program planning and budgeting for public goods and services cannot be done in an effective and realistic manner without the use of demographic estimates and projections.

This report presents current estimates and projections to 1990 for Delaware population and higher education enrollment. The population estimates and projections are tabulated by age and sex for the total population of the State and by single years of age for the population of college age. The enrollment estimates and projections are tabulated by institution for member institutions of the Delaware Higher Educational Aid Advisory Commission. The text of the report contains an introduction, a section on methods and assumptions, and a section on limitations. The last section is followed by a series of tables containing the population and enrollment estimates and projections.

METHODS AND ASSUMPTIONS

The following discussions concern the methods and assumptions used to assemble the statistical information presented in this report. The first discussion focuses upon the population projections. These projections were prepared using conventional techniques of population analysis. The second discussion concerns the enrollment projections; they were derived from the population projections to insure consistent results and continuity of methods and assumptions.

Population Projections.

An initial age distribution represents the point of departure for all population projections. The initial age distributions for the Delaware projections were derived from the 1970 Census of Population.¹ The actual census figures were not used, however, because the projections were prepared on a midyear basis. A minor adjustment was necessary to convert the reported age distributions from the original date of 1 April to the midyear date of 1 July.² The estimated initial populations by age and sex are shown in the first column of table 1.

Projecting future population growth involves a mechanically simple procedure.³ This procedure can be summarized in the following manner. Consider an initial population distributed by age and sex. The time interval between

¹U.S. Bureau of the Census, Census of Population: 1970 Detailed Characteristics, Final Report PC(1)-D9 Delaware, table 138, pp. 9-183.

²United Nations, Department of Economic and Social Affairs, Methods of Estimating Basic Demographic Measures from Incomplete Data (ST/SOA/Series A/42), 1967, p. 58.

³N. Keyfitz, Introduction to the Mathematics of Population (Reading, Mass.: Addison-Wesley, 1968), pp. 27-37.

the date of this population and the first projection, and the time interval separating all subsequent projections, is called the projection period. The length of this period will be generally either one year or five years, depending upon the age convention. Populations distributed by single years of age will produce annual projections, while populations arrayed in five-year age groups will produce quinquennial projections. The logic of this statement should be apparent to readers at all levels of sophistication.

Suppose now, that an initial population distributed by quinquennial age groups and sex is to be projected for one projection period. The first step in the projection procedure involves cohort survivorship. Survival ratios obtained from appropriate life tables are applied to the age and sex cohorts in the initial population. This determines the expected age and sex composition for the projected population above age five. The second step in the procedure is to estimate the number of births during the projection period. There are several ways in which this can be done, but the most defensible technique involves using a schedule of birth rates by age of mother. These rates are applied to the female cohorts of childbearing age in the average of the initial and projected populations to yield the quinquennial birth cohort. The sex distribution of this cohort can be estimated using an appropriate sex ratio at birth. The projected population under age five can then be determined simply by applying survival ratios to the estimated female and male birth cohorts. The final step in the projection procedure involves an adjustment of the projected age distributions for net migration. This represents another step for which there are several techniques. The method chosen for this report is based upon net migration ratios. These ratios represent the proportionate change in cohort size attributable to net migration during the

projection period. They are applied directly to the age and sex cohorts in the projected population to obtain the projected age distributions adjusted for net migration.

An initial age distribution combined with a mechanically simple procedure will not produce a population projection. Certain assumptions about the behavior of fertility, mortality, and migration during the projection period must be made before any projection can be assembled. These assumptions are central to a projection, because they determine the form that projection will take. Different assumptions will produce different projections, given the same initial age distribution. The credibility of a population projection depends upon the plausibility of each assumption at a given point in time. If the assumptions are not plausible at this point in time, then the projection will find difficulty gaining acceptance, even though the passage of time may show the assumptions to have been correct. The population projections presented in this report were prepared under the following set of assumptions. The first assumption concerns fertility.

The total fertility rate measures the average number of children ever born to women who survive the childbearing years.⁴ The Delaware total fertility rate for the period from 1969 to 1971 was 2.46. This means that a cohort of women exposed continuously to the fertility schedule underlying this particular total fertility rate would produce ultimately an average of 2.46 children, allowing for the effect of female mortality. The past 15 years have witnessed a considerable reduction in the level of American

⁴G. Barclay, Techniques of Population Analysis (New York: Wiley, 1958), pp. 52-53.

fertility, including the level of Delaware fertility. If the present trend continues at least for the immediate future, then the United States will converge to a replacement population. Evidence assembled by the Census Bureau concerning national birth expectations indicates that the average woman just beginning her reproductive career anticipates a completed family size of 2.30 children.⁵ Since Delaware approximates the United States in reproductive behavior, the 2.30 figure was assumed to be the 1990 Delaware total fertility rate. Annual birth rates by age of mother were constructed for 1990, using the assumed total fertility rate and the age structure of Delaware fertility for the period from 1969 to 1971.⁶ Fertility schedules were then constructed by linear interpolation for each quinquennium from 1970 to 1990. These schedules and the corresponding total fertility rates are shown in table 3. This explains the fertility assumption. The next assumption concerns mortality.

Continuous improvements in disease control technology and preventive medicine have been responsible for more than a century of declining mortality in the United States. There is no evidence to suggest that Delaware has not been a party to these fortunate circumstances. Preliminary 1972 estimates derived from information assembled by the National Center for Health Statistics

⁵U. S. Bureau of the Census, Current Population Reports, Series P-20 No. 248, "Birth Expectations and Fertility: June 1972," p. 1.

⁶The original fertility schedule was assembled for New Castle County, Delaware, using birth registration data classified by age of mother for the period from 1969 to 1971. These data were provided by the Census and Data System, Division of Urban Affairs, University of Delaware. The fertility schedule for New Castle County was converted to a Delaware schedule by assuming that both regions have the same age structure of fertility (a very plausible assumption) and then adjusting the county schedule to the estimated 1969-1971 Delaware total fertility rate.

place the Delaware female expectation of life at birth at 73 years, the corresponding male figure at 70 years, and the infant mortality rate at 19 per thousand live births.⁷ The scientific community has forecasted further improvements in disease control technology and preventive medicine through the year 2000, but most experts agree that the incremental change in mortality indices will be smaller than before and more difficult to achieve. This statement suggests a small increase in the Delaware expectation of life at birth during the next 20 years and a correspondingly small decrease in the infant mortality rate. The most recent Delaware life tables were constructed for the period from 1959 to 1961.⁸ Since this period, the general conditions of mortality have not undergone a radical transformation. There have been significant improvements at each end of the age spectrum, however, and these improvements are sufficient to render useless the Delaware life tables for the period from 1959 to 1961. Current life tables for the period from 1969 to 1971 are being assembled at the National Center for Health Statistics, but these life tables have not been published.

Since the older life tables do not represent adequately current and projected Delaware mortality and the newer life tables are not yet available, the population projections presented in this report were prepared using standard life tables. Coale and Demeny have assembled a set of regional

⁷ National Center for Health Statistics, Monthly Vital Statistics Report, "Annual Summary for the United States, 1972," June 27, 1973, table 2, p. 15. The female and male expectations of life at birth were derived from the published data.

⁸ National Center for Health Statistics, Life Tables: 1959-61, "Delaware Life Tables: 1959-61," October 1967, tables 1 and 2, pp. 102-105.

model life tables and stable populations to assist demographers with population research in the presence of incomplete information.⁹ The standard life tables chosen for Delaware are the West model life tables at level 23. The expectation of life at birth is 75 years in the female life table and 71 years in the male life table. The composite infant mortality rate is 18 per thousand live births. These statistics represent the type of incremental change in mortality indices which population experts have agreed will materialize during the next several decades. The expectation of life at birth is two years higher in the female life table and one year higher in the male life table and the composite infant mortality rate is one point lower, compared with preliminary 1972 estimates. Since the standard life tables chosen for Delaware are assumed to represent average mortality conditions during the next 20 years, the survival ratios were held constant for each quinquennial projection period from 1970 to 1990. These survival ratios are shown in table 4. This explains the mortality assumption. The final assumption concerns migration.

The disproportionate volume of scholarly literature concerning fertility and mortality provides sufficient evidence to support the contention that migration is the last frontier of population research. International migration received considerable attention during the early part of the present century. European movement to the United States made international migration an important and appropriate subject of inquiry among scholars and statesmen. Internal migration has never received the attention given international

⁹ A. Coale and P. Demeny, Regional Model Life Tables and Stable Populations (Princeton: Princeton University Press, 1966), p. 24.

migration, however. Scholars and statesmen are just beginning to recognize internal migration as an increasingly important component of regional population growth. The problem associated with the study of internal migration is essentially a problem of observation. There is nothing comparable to the vital registration system for births and deaths to record the number of different migration events during a given time period.

The most commonly used technique for estimating net migration treats migration as a residual component of population growth.¹⁰ This technique involves a comparison of two consecutive population censuses. Adding the number of births during the intercensal period to the initial census figure and then subtracting the number of intercensal deaths yields the expected population at the second census on the basis of natural increase. The difference between this expected population and the enumerated population is assumed to represent net migration. This procedure produces accurate estimates of net migration for populations with complete census enumeration and vital registration. If census data and vital statistics are subject to differential completeness of coverage, then the procedure will produce estimates containing elements of both net migration and statistical discrepancy. The extent of this bias is usually within tolerable limits, however, and does not cause a serious problem.

¹⁰United Nations, Department of Economic and Social Affairs, Methods of Measuring Internal Migration (ST/SOA/Series A/47), 1970, pp. 24-36. Techniques for estimating net migration as a residual component of population growth are called indirect measurement techniques. The most commonly used indirect measurement techniques are the vital statistics method and the survival ratio method. Although these two techniques differ somewhat in methodological approach, they produce essentially the same results for a given set of data.

The migration estimates used to prepare the population projections presented in this report are shown in table 5. These estimates are called net migration ratios. They represent the proportionate change in cohort size attributable to net migration during each quinquennial projection period. The estimates presented in table 5 were derived in the following manner. The 1960 and 1970 Delaware Censuses of Population were compared using the residual estimation technique to produce a set of net migration ratios distributed by age and sex for the period from 1965 to 1970. The assumption was then made that the rate of net migration for each age and sex cohort would decline 50 percent by 1990. Net migration ratios were computed for the period from 1990 to 1995 based on this assumption. The figures shown in table 5 were obtained by linear interpolation.

The assumption that net migration will decline during the next 20 years has a certain intuitive appeal. Delaware cannot continue to sustain net migration at the present average annual rate. Future reductions in the aggregate rate of net migration are inevitable; these reductions are not inconsistent with increased population mobility. The extent to which net migration will decline during the next 20 years is appropriately a matter for speculation. An assumed reduction of 50 percent is certainly plausible.

This completes the discussion of methods and assumptions concerning the population projections. The following discussion focuses upon the enrollment projections, with particular emphasis again on methods and assumptions.

Enrollment Projections.

The enrollment projections presented in this report were derived from the population projections. The derivation procedure is mechanically simple and can be summarized in the following manner. The first step involves an

estimate of the population of college age. The college-age cohort for purposes of this report was defined to be the population group aged 18 to 24. Since the projected populations are tabulated by quinquennial age groups, it was necessary to graduate two of these age groups by single years of age. This was done using Sprague multipliers.¹¹ These multipliers were applied to the cohorts aged 15 to 19 and 20 to 24 in each projected population, producing estimates of cohort size by annual age groups. The corresponding populations of college age could then be constructed by simple summation. These figures are shown in table 2.

The second step in the projection procedure requires estimates of the resident undergraduate enrollment at member institutions of the Delaware Higher Educational Aid Advisory Commission for each quinquennial year from 1970 to 1990. These estimates were prepared using what may be referred to as a resident attendance rate. This rate equals the resident undergraduate enrollment at all Commission institutions divided by the population of college age; the numerator of the rate is expressed in full-time equivalent (FTE) units.¹² The average annual resident attendance rate for the period from

¹¹U. S. Bureau of the Census, The Methods and Materials of Demography, prepared by H. Shryock, J. Siegal, and Associates, 1973, vol. II, pp. 687-689.

¹²The full-time equivalent index represents the sum of full-time students plus one-third of part-time students, except for Delaware Technical and Community College, which uses one-tenth of the part-time figure rather than one-third. A full-time student is one who carries at least 75 percent of a normal student load, while a part-time student is one who carries less than 75 percent of a normal student load.

1969 to 1971 was 0.1576.¹³ This means that approximately 16 percent of the Delaware population of college age was enrolled in FTE undergraduate status at Commission institutions during the period under consideration. The question that must be answered for the enrollment projections concerns the future course of the resident attendance rate during the next 20 years.

Since the market for higher education can change dramatically over a relatively short time period in response to changing economic and social conditions, the preparation of more than one set of projected enrollment figures represents an advisable course of action. There are three sets of figures presented in this report; each set was prepared under a different assumption concerning the future course of the resident attendance rate. The first set of figures assumes a continuation of the present rate for the period from 1969 to 1971 through at least 1990. These figures are shown in table 6. They are designated Series A projections and are intended to represent a low variant of future enrollment growth. The second set of figures assumes what may be considered a rather conservative increase in the resident attendance rate to a value of 0.20 by 1990. These figures are shown in table 7. They are designated Series B projections and are intended to represent a medium variant of future enrollment growth. The final set of figures are shown in table 8. These figures assume a rather liberal increase in the resident attendance rate to a value of 0.25 by 1990. They are designated Series C

¹³ This figure (0.1576) was computed in the following manner. The average annual full-time equivalent undergraduate enrollment at Commission institutions for the period from 1969 to 1971 was 10,037. This is the average of the three "Grand Total" figures shown in table 12. The estimated population of college age on July 1, 1970, was 63,683. This figure is shown in table 2. The enrollment figure (10,037) divided by the state population figure (63,683) equals the resident attendance rate (0.1576).

projections and are intended to represent a high variant of future enrollment growth.

Two important factors suggest the distinct possibility of relatively higher enrollment during the next 20 years. The first factor concerns college attendance on a part-time basis. There is a general consensus among educational planners that the part-time component of FTE undergraduate enrollment will increase out of proportion to the full-time component and population growth during the next several decades. High school seniors and other individuals who would otherwise not attend college under any circumstances will find the pursuit of higher education on a part-time basis quite compatible with family formation and participation in the labor force. The greatest demand will be for continuing education and university extension programs offering either professional certification or the associate degree. These programs are advantageous for several reasons. First, they generate a positive rate of return on a relatively small investment, because they almost always produce expanded employment opportunities. Second, students of limited financial means can take the necessary coursework at a university or community college campus within easy commuting distance of home.

The second factor suggesting the distinct possibility of relatively higher college enrollment concerns students who plan to attend college on a full-time basis outside the State. These students presently represent a significant and unfortunate loss to the Delaware higher education system. They have chosen the schools they plan to attend for reasons they consider important, and they have decided further to absorb higher tuition and fees to realize their educational plans. The extent to which Delaware will continue to lose students to public and private institutions in other states

depends upon both monetary and nonmonetary factors. There will always be some students leaving the state of their legal residence to attend schools elsewhere, but the rate of this academic migration will decline during the next several decades. The expanded efforts of colleges and universities, including junior colleges, to attract a larger student population and the added pressures on potential students to seek higher education at a lower cost will provide sufficient incentive for an increasing number of residents planning to attend school outside Delaware to reconsider their decision. If these potential sources of new enrollment materialize at a rate faster than population growth during the next 20 years, then the resident attendance rate will have risen by 1990. The magnitude of this increase is appropriately a matter for speculation. The figures used to prepare the enrollment projections presented in this report define a plausible range of possible outcomes.

Multiplying the resident attendance rate by the population of college age yields the aggregate FTE undergraduate enrollment at Commission institutions on the date in question. The third step in the enrollment projection procedure is to distribute this pool of FTE students among the member institutions. The average annual distribution for the period from 1969 to 1971 is shown in the first column of table 6. The same figures are reproduced in column one of tables 7 and 8 to facilitate the comparison of projected and reported information. Two assumptions were made to produce the projected figures in these tables. The first assumption concerns the annual distribution of aggregate enrollment between the public and private sectors. The reported data for the period from 1969 to 1971 indicate that public institutions accounted for almost 90 percent of all resident FTE undergraduate enrollment. The assumption was made that this figure would increase to 93 percent by 1990. If Delaware

realizes the full potential of the market for higher education during the next 20 years, then the public institutions in the State will gain relative to the private institutions. The reason for this differential growth involves a simple lesson in economics.

Public institutions have a definite comparative advantage in the provision of continuing education and university extension coursework. These institutions operate on a larger scale than most private institutions, making it possible for them to offer a wide range of both full-time and part-time programs and remain financially solvent in the process. The average private institution will not indulge to this extent, considering the importance of economic efficiency in the provision of educational services and the production of human capital. Since public institutions dominate the market for part-time instruction and potential enrollment patterns for the next 20 years indicate a substantial expansion of this market, then it stands to reason that public institutions will control a larger share of the total market by 1990 than they do at present. The important assumption in this argument concerns the future of resident FTE undergraduate enrollment. Public institutions will gain relative to private institutions only if the market for part-time instruction expands during the next several decades in the manner suggested above. If the market does not expand along these lines, then differential growth between the public and private sectors will no longer be a distinct possibility.

The second assumption underlying the projected figures in tables 6, 7, and 8 concerns the patterns of differential growth between individual institutions. The reader should recognize and understand the highly tenuous nature of this assumption. The preceding discussion contains no other assumption so strongly influenced by policy considerations and limitational factors beyond

the control of institution officials. The basic assumption is divided into two parts. The first part specifies that there will be no differential growth between private institutions during the next 20 years. This means that the distribution of resident FTE undergraduate enrollment among private Commission institutions will be the same in 1990 as it was during the period from 1969 to 1971. The need to use limited information provides the best defense for this part of the basic assumption. The enrollment records of Delaware private institutions are not sufficiently well established to permit a reliable determination of growth trends.¹⁴ When all of these institutions have been in continuous operation for a longer time period than is presently the case, a better estimate can be made of differential growth patterns. The best estimate under present conditions is the assumption that resident FTE undergraduate enrollment will increase in constant proportion at private Commission institutions at least through 1990.

The second part of the basic assumption concerns differential growth between public Commission institutions. This is assumed to occur in the following manner. The Delaware Technical and Community College system will increase its share of the public sector from approximately 19 percent for the period from 1969 to 1971 to 30 percent by 1990. Private institutions, Delaware State College, and the University will sustain proportionate reductions in resident FTE undergraduate enrollment to account for the improved

¹⁴ A realistic assessment of differential growth for a given set of institutions requires that each institution have been in continuous operation for at least 10 years and preferably longer. Brandywine College was established in 1965, Goldey Beacom College in 1886, Wesley College in 1873, and Wilmington College in 1968. Although two of these institutions have well-established enrollment records, the longest period during which all four institutions have been in continuous operation is only five years.

position of the community college system. There are two important considerations in this part of the basic assumption. The first concerns academic heritage. The University of Delaware was founded in 1833, and Delaware State College was established in 1891. Both of these institutions are well entrenched in the state market for higher education. The community college system, however, is not so well entrenched. It began operating only quite recently, in 1967, and its full impact on the Delaware market for higher education is probably yet to be felt. This would definitely suggest an improved market position during the next several decades.

The second important consideration in the second part of the basic assumption involves courses and programs. The current period in American history has witnessed a radical transformation of traditional academic values. Universal higher education continues to be a driving force in contemporary society, but the emphasis is no longer on the production of Renaissance scholars. Colleges and universities, including junior colleges, are now in the business of vocational and technical training. Many students prefer this approach because it enables them to deal effectively with an uncertain labor market. Vocational and technical training can be pursued at more than one level in the educational system, but an increasing number of students are choosing programs offered by junior colleges leading to either professional certification or the associate degree. These programs require a relatively small investment, an important consideration for persons of limited financial means, and the necessary coursework can usually be taken at a campus located within reasonable commuting distance of home. Add to these advantages an impressive placement record and it is easy to see why most junior colleges have been relatively successful. If vocational and technical training continues

to dominate American higher education during the next several decades and students continue to seek the best possible training of this type at the lowest possible cost, then junior colleges can expect to benefit in terms of enrollment relative to private institutions and other public institutions. The potential impact of a new junior college system on the state market for higher education combined with an increasing demand for vocational and technical training will produce an improved market position for the Delaware Technical and Community College system during the next 20 years. The assumption that the market share will increase to 30 percent by 1990 is certainly plausible.

The final step in the enrollment projection procedure concerns the estimation of total FTE undergraduate enrollment at Commission institutions. This step involves an adjustment of the projected data presented in tables 6, 7, and 8 to allow for nonresident enrollment. These adjusted figures are shown in tables 9, 10, and 11. Table 9 contains the Series A (low variant) projections, derived from the data presented in table 6. Table 10 contains the Series B (medium variant) projections, derived from the data presented in table 7. Table 11 contains the Series C (high variant) projections, derived from the data presented in table 8. The adjusted figures shown in tables 9, 10, and 11 were assembled in the following manner. The proportion nonresident FTE undergraduate enrollment was computed for each Commission institution using data for the period from 1969 to 1971. The assumption was then made that each proportion would remain constant at the computed value at least through 1990. Dividing the projected resident enrollment figures shown in tables 6, 7, and 8 by one minus the proportions nonresident produced the total enrollment figures shown in tables 9, 10, and 11.

The plausibility of these figures depends upon the future Delaware market for nonresident instruction and the extent to which institutional policies limit nonresident enrollment. Quotas imposed by the University of Delaware will have the largest single effect upon nonresident participation in the state system of higher education. If the University is confronted by an increasing demand for resident enrollment during the next several decades, then nonresident quotas may decline, providing there is no major campus expansion. A slackening demand for resident enrollment in the immediate future will produce the opposite effect.

Whether the current patterns of nonresident enrollment at Commission institutions will continue at least through 1990 is appropriately a matter for speculation. Some educational planners contend that cost and quality factors will operate to reduce the relative size of the nonresident market, but the same planners have not been able to specify the extent and timing of any potential reduction. Since these considerations are central from the standpoint of projection analysis, the current patterns of nonresident enrollment at Commission institutions represent what may be considered a best estimate of future patterns. Best estimates always guarantee plausible assumptions.

LIMITATIONS

The population and higher education enrollment projections presented in this report are subject to certain limitations. The reader should recognize these limitations and appreciate the restrictions they impose on interpretation. Three limitations deserve comment in the present context. The first involves the general assumption that there will be no disastrous war, widespread epidemic, major economic depression, or similar catastrophe during the period under consideration. This assumption constitutes standard

procedure in demographic analysis. Although extraordinary and unusual events can have a pronounced effect on population growth and related phenomena, the forecasting problem becomes sufficiently complex to render the task of prediction impractical. The second limitation to which the projections are subject concerns the completeness of census enumeration.

The initial age distributions for 1970 were derived from official figures reported in the decennial census. The reader will recall a minor adjustment to these figures, converting them from the original date of 1 April to the midyear date of 1 July. This adjustment altered the absolute size of each age and sex cohort, but it produced no effect whatsoever on relative size. This means that the enumerated proportionate age distributions are preserved in the midyear estimates. It also means that the July figures are subject to the same differential completeness of coverage by age and sex as the figures published for April. Preliminary 1972 estimates of net census undercount assembled by the Census Bureau indicate a significant deterioration in the completeness of coverage at the national level between 1960 and 1970.¹⁵ These estimates suggest further that much of this deterioration is concentrated in the youngest age groups.

There is no reason to suspect that Delaware and the United States have even remotely similar age and sex patterns of net census undercount, but significant undercounting among the youngest Delaware age groups in 1970 remains a distinct possibility. The reason for this statement concerns the projected population aged 20 to 24 in 1990. The size of this cohort is

¹⁵ J. Siegal, "Estimates of Coverage of the Population by Sex, Race, and Age in the 1970 Census," Paper presented at the annual meeting of the Population Association of America, New Orleans, April 26, 1973, p. 4.

curiously small, compared with adjacent cohorts in the same age distribution. It definitely accounts for the interestingly small population of college age in the same year. The cohort aged 20 to 24 in 1990 contains the survivors of the census population under age five in 1970, with intervening adjustments for net migration. Whether the cohort was subject to significant underenumeration in 1970, in which case the relative error would have been transmitted to 1990 by the projection mechanism, or whether the cohort was simply the product of changing reproductive behavior during the period from 1965 to 1970 is difficult to establish without lengthy deliberation and resort to something more than circumstantial evidence. The correct solution may even involve a combination of these two possibilities. This example illustrates an important consideration in the mathematical analysis of population growth. The projection procedure is very sensitive to the statistical quality of the population data base. If the original data base used to prepare a given set of projections contains certain distortions, then the projected information will also contain these distortions. This can impose serious restrictions on interpretation, depending upon the size of the geographical unit under consideration.

The final limitation to which the projections are subject concerns the assumptions. This limitation not only influences population and enrollment projections, but all projections. Assumptions are central to projections, by definition. The reader is admonished always to recognize assumptions, appreciate them for their complexity, and judge them strictly on the basis of their plausibility. The credibility of a projection depends upon the plausibility of each assumption at a given point in time. If the assumptions are not plausible at this point in time, then the projection will find difficulty gaining acceptance, even though the passage of time may show the assumptions to have been correct.

TABLES

TABLE 1

POPULATION OF DELAWARE, BY AGE AND SEX:
1970 AND PROJECTIONS, 1975, 1980, 1985, AND 1990

Female

<u>Age Group</u>	<u>1970</u>	<u>1975</u>	<u>1980</u>	<u>1985</u>	<u>1990</u>
0-4	23,858	26,943	31,908	34,946	35,261
5-9	28,122	24,743	27,802	32,759	35,697
10-14	29,693	29,157	25,528	28,544	33,467
15-19	26,019	30,885	30,166	26,271	29,216
20-24	23,360	28,106	33,024	31,924	27,513
25-29	19,262	26,172	31,028	35,915	34,195
30-34	16,926	21,290	28,548	33,395	38,133
35-39	16,534	17,544	21,950	29,275	34,061
40-44	16,989	16,594	17,582	21,966	29,255
45-49	17,401	17,122	16,682	17,629	21,968
50-54	14,969	16,950	16,695	16,282	17,224
55-59	12,729	14,292	16,220	16,012	15,650
60-64	10,820	12,067	13,558	15,399	15,212
65-69	7,949	9,339	10,509	11,913	13,649
70-74	7,320	6,905	8,108	9,119	10,332
75+	10,783	11,882	12,063	13,049	14,299
Total	282,734	309,991	341,371	374,398	405,132

Male

0-4	25,040	28,372	33,600	36,800	37,131
5-9	29,595	25,937	29,242	34,455	37,545
10-14	30,333	30,656	26,737	29,995	35,168
15-19	26,134	31,507	31,673	27,476	30,658
20-24	20,553	28,165	33,611	33,442	28,709
25-29	18,593	22,976	31,025	36,473	35,741
30-34	16,407	20,515	25,020	33,334	38,659
35-39	16,015	16,978	21,117	25,616	33,945
40-44	16,184	16,038	16,978	21,086	25,541
45-49	16,696	16,245	16,057	16,955	21,003
50-54	14,682	16,133	15,712	15,546	16,431
55-59	11,474	13,795	15,193	14,830	14,706
60-64	9,708	10,583	12,733	14,033	13,708
65-69	6,382	8,050	8,854	10,748	11,950
70-74	4,979	5,254	6,624	7,282	8,835
75+	6,198	6,942	7,479	8,730	9,784
Total	268,973	298,146	331,655	366,801	399,514

Note: Population data are midyear figures.

TABLE 2

POPULATION OF COLLEGE AGE, BY SINGLE YEARS OF AGE,
FOR THE POPULATION OF DELAWARE:
1970 AND PROJECTIONS, 1975, 1980, 1985, AND 1990

<u>Age</u>	<u>1970</u>	<u>1975</u>	<u>1980</u>	<u>1985</u>	<u>1990</u>
18	10,041	12,443	12,803	10,773	11,626
19	9,733	12,171	12,993	11,401	11,347
20	9,403	11,874	13,193	12,008	11,098
21	9,059	11,540	13,387	12,633	10,837
22	8,743	11,217	13,466	13,192	10,871
23	8,472	10,942	13,389	13,611	11,336
24	8,232	10,693	13,197	13,918	12,075
Total	63,683	80,880	92,428	87,536	79,190

Note: Population data are midyear figures.

TABLE 3

PROJECTED ANNUAL BIRTH RATES BY AGE OF MOTHER
AND TOTAL FERTILITY RATES (TFR) FOR THE POPULATION OF DELAWARE:
1970-1975 TO 1985-1990

<u>Age Group</u>	<u>1970-1975</u>	<u>1975-1980</u>	<u>1980-1985</u>	<u>1985-1990</u>
15-19	0.0683	0.0672	0.0661	0.0650
20-24	0.1521	0.1496	0.1471	0.1446
25-29	0.1620	0.1593	0.1567	0.1540
30-34	0.0685	0.0674	0.0663	0.0652
35-39	0.0293	0.0288	0.0283	0.0278
40-44	0.0068	0.0067	0.0066	0.0065
45-49	0.0010	0.0010	0.0009	0.0009
TFR	2.4400	2.4000	2.3600	2.3200

TABLE 4
PROJECTED SURVIVAL RATIOS, BY AGE AND SEX,
FOR THE POPULATION OF DELAWARE:
1970-1975 TO 1985-1990

<u>Female</u>				
<u>Age Group</u>	<u>1970-1975</u>	<u>1975-1980</u>	<u>1980-1985</u>	<u>1985-1990</u>
Birth	0.9840	0.9840	0.9840	0.9840
0-4	0.9979	0.9979	0.9979	0.9979
5-9	0.9988	0.9988	0.9988	0.9988
10-14	0.9986	0.9986	0.9986	0.9986
15-19	0.9979	0.9979	0.9979	0.9979
20-24	0.9971	0.9971	0.9971	0.9971
25-29	0.9963	0.9963	0.9963	0.9963
30-34	0.9950	0.9950	0.9950	0.9950
35-39	0.9927	0.9927	0.9927	0.9927
40-44	0.9883	0.9883	0.9883	0.9883
45-49	0.9813	0.9813	0.9813	0.9813
50-54	0.9707	0.9707	0.9707	0.9707
55-59	0.9531	0.9531	0.9531	0.9531
60-64	0.9211	0.9211	0.9211	0.9211
65-69	0.8652	0.8652	0.8652	0.8652
70-74	0.7759	0.7759	0.7759	0.7759
75+	0.5197	0.5197	0.5197	0.5197
<u>Male</u>				
Birth	0.9774	0.9774	0.9774	0.9774
0-4	0.9967	0.9967	0.9967	0.9967
5-9	0.9979	0.9979	0.9979	0.9979
10-14	0.9972	0.9972	0.9972	0.9972
15-19	0.9956	0.9956	0.9956	0.9956
20-24	0.9949	0.9949	0.9949	0.9949
25-29	0.9946	0.9946	0.9946	0.9946
30-34	0.9934	0.9934	0.9934	0.9934
35-39	0.9905	0.9905	0.9905	0.9905
40-44	0.9843	0.9843	0.9843	0.9843
45-49	0.9734	0.9734	0.9734	0.9734
50-54	0.9553	0.9553	0.9553	0.9553
55-59	0.9273	0.9273	0.9273	0.9273
60-64	0.8849	0.8849	0.8849	0.8849
65-69	0.8200	0.8200	0.8200	0.8200
70-74	0.7259	0.7259	0.7259	0.7259
75+	0.4806	0.4806	0.4806	0.4806

TABLE 5

PROJECTED NET MIGRATION RATIOS, BY AGE AND SEX,
FOR THE POPULATION OF DELAWARE:
1970-1975 TO 1985-1990

<u>Female</u>				
<u>Age Group</u>	<u>1970-1975</u>	<u>1975-1980</u>	<u>1980-1985</u>	<u>1985-1990</u>
0-4	1.0298	1.0258	1.0219	1.0179
5-9	1.0393	1.0341	1.0288	1.0236
10-14	1.0381	1.0330	1.0279	1.0228
15-19	1.0416	1.0361	1.0305	1.0250
20-24	1.0285	1.0715	1.0605	1.0495
25-29	1.1237	1.1072	1.0907	1.0742
30-34	1.1094	1.0948	1.0803	1.0657
35-39	1.0417	1.0362	1.0306	1.0251
40-44	1.0111	1.0096	1.0081	1.0066
45-49	1.0198	1.0172	1.0145	1.0119
50-54	0.9927	0.9937	0.9946	0.9956
55-59	0.9836	0.9858	0.9880	0.9902
60-64	0.9947	0.9954	0.9961	0.9968
65-69	0.9371	0.9455	0.9539	0.9623
70-74	1.0040	1.0035	1.0030	1.0025
75+	1.0531	1.0460	1.0389	1.0318
<u>Male</u>				
0-4	1.0298	1.0258	1.0219	1.0179
5-9	1.0393	1.0341	1.0288	1.0236
10-14	1.0381	1.0330	1.0279	1.0228
15-19	1.0416	1.0361	1.0305	1.0250
20-24	1.0825	1.0715	1.0605	1.0495
25-29	1.1237	1.1072	1.0907	1.0742
30-34	1.1094	1.0948	1.0803	1.0657
35-39	1.0417	1.0362	1.0306	1.0251
40-44	1.0111	1.0096	1.0081	1.0066
45-49	1.0198	1.0172	1.0145	1.0119
50-54	0.9927	0.9937	0.9946	0.9956
55-59	0.9836	0.9858	0.9880	0.9902
60-64	0.9947	0.9954	0.9961	0.9968
65-69	0.9371	0.9455	0.9539	0.9623
70-74	1.0040	1.0035	1.0030	1.0025
75+	1.0531	1.0460	1.0389	1.0318

TABLE 6

RESIDENT UNDERGRADUATE ENROLLMENT AT MEMBER INSTITUTIONS
OF THE DELAWARE HIGHER EDUCATIONAL AID ADVISORY COMMISSION:
AVERAGE 1969-1971 AND SERIES A PROJECTIONS, 1975, 1980, 1985, AND 1990

<u>Institution</u>	<u>Average 1969-1971</u>	<u>1975</u>	<u>1980</u>	<u>1985</u>	<u>1990</u>
Delaware State College	1,007	1,247	1,388	1,279	1,126
Delaware Technical and Community College (N)	885	1,356	1,814	1,969	2,008
Delaware Technical and Community College (S)	813	1,151	1,450	1,501	1,474
University of Delaware	6,304	7,792	8,659	7,969	6,999
Total Public	9,009	11,546	13,311	12,718	11,607
Brandywine College	333	389	407	349	283
Goldey Beacom College	322	377	393	338	274
Wesley College	218	255	266	228	185
Wilmington College	155	181	189	162	132
Total Private	1,028	1,202	1,255	1,077	874
Grand Total	10,037	12,748	14,566	13,795	12,481

Note: Enrollment figures are expressed in full-time equivalent units.

RESIDENT UNDERGRADUATE ENROLLMENT AT MEMBER INSTITUTIONS
OF THE DELAWARE HIGHER EDUCATIONAL AID ADVISORY COMMISSION:
AVERAGE 1969-1971 AND SERIES B PROJECTIONS, 1975, 1980, 1985, AND 1990

<u>Institution</u>	<u>Average 1969-1971</u>	<u>1975</u>	<u>1980</u>	<u>1985</u>	<u>1990</u>
Delaware State College	1,007	1,330	1,574	1,538	1,429
Delaware Technical and Community College (N)	885	1,447	2,058	2,366	2,548
Delaware Technical and Community College (S)	813	1,228	1,645	1,804	1,871
University of Delaware	6,304	8,316	9,824	9,576	8,882
Total Public	9,009	12,321	15,101	15,284	14,730
Brandywine College	333	416	462	420	359
Goldey Beacom College	322	402	446	406	347
Wesley College	218	272	302	275	235
Wilmington College	155	193	215	195	167
Total Private	1,028	1,283	1,425	1,296	1,108
Grand Total	10,037	13,604	16,526	16,580	15,838

Note: Enrollment figures are expressed in full-time equivalent units.

TABLE 8

RESIDENT UNDERGRADUATE ENROLLMENT AT MEMBER INSTITUTIONS
OF THE DELAWARE HIGHER EDUCATIONAL AID ADVISORY COMMISSION:
AVERAGE 1969-1971 AND SERIES C PROJECTIONS, 1975, 1980, 1985, AND 1990

<u>Institution</u>	<u>Average 1969-1971</u>	<u>1975</u>	<u>1980</u>	<u>1985</u>	<u>1990</u>
Delaware State College	1,007	1,429	1,795	1,842	1,786
Delaware Technical and Community College (N)	885	1,554	2,346	2,835	3,185
Delaware Technical and Community College (S)	813	1,319	1,875	2,162	2,338
University of Delaware	6,304	8,934	11,197	11,473	11,103
Total Public	9,009	13,236	17,213	18,312	18,412
Brandywine College	333	447	526	503	449
Goldey Beacom College	322	432	509	486	434
Wesley College	218	292	344	329	294
Wilmington College	155	208	245	234	209
Total Private	1,028	1,379	1,624	1,552	1,386
Grand Total	10,037	14,615	18,837	19,864	19,798

Note: Enrollment figures are expressed in full-time equivalent units.

TABLE 9

TOTAL UNDERGRADUATE ENROLLMENT AT MEMBER INSTITUTIONS
OF THE DELAWARE HIGHER EDUCATIONAL AID ADVISORY COMMISSION:
AVERAGE 1969-1971 AND SERIES A PROJECTIONS, 1975, 1980, 1985, AND 1990

<u>Institution</u>	<u>Average 1969-1971</u>	<u>1975</u>	<u>1980</u>	<u>1985</u>	<u>1990</u>
Delaware State College	1,443	1,786	1,988	1,833	1,613
Delaware Technical and Community College (N)	926	1,418	1,898	2,059	2,100
Delaware Technical and Community College (S)	881	1,247	1,571	1,627	1,597
University of Delaware	8,850	10,943	12,162	11,192	9,830
Total Public	12,100	15,394	17,619	16,711	15,140
Brandywine College	1,355	1,583	1,654	1,419	1,151
Goldey Beacom College	938	1,098	1,147	984	798
Wesley College	858	1,004	1,048	899	729
Wilmington College	434	508	530	455	369
Total Private	3,585	4,193	4,379	3,757	3,047
Grand Total	15,685	19,587	21,998	20,468	18,187

Note: Enrollment figures are expressed in full-time equivalent units.

TABLE 10

TOTAL UNDERGRADUATE ENROLLMENT AT MEMBER INSTITUTIONS
OF THE DELAWARE HIGHER EDUCATIONAL AID ADVISORY COMMISSION:
AVERAGE 1969-1971 AND SERIES B PROJECTIONS, 1975, 1980, 1985, AND 1990

<u>Institution</u>	<u>Average 1969-1971</u>	<u>1975</u>	<u>1980</u>	<u>1985</u>	<u>1990</u>
Delaware State College	1,443	1,906	2,256	2,203	2,047
Delaware Technical and Community College (N)	926	1,513	2,153	2,475	2,665
Delaware Technical and Community College (S)	881	1,331	1,782	1,955	2,027
University of Delaware	8,850	11,679	13,797	13,450	12,474
 Total Public	 12,100	 16,429	 19,988	 20,083	 19,213
 Brandywine College	 1,355	 1,690	 1,876	 1,705	 1,460
Goldey Beacom College	938	1,172	1,301	1,183	1,013
Wesley College	858	1,071	1,189	1,081	925
Wilmington College	434	542	602	547	468
 Total Private	 3,585	 4,475	 4,968	 4,516	 3,866
 Grand Total	 15,685	 20,904	 24,956	 24,599	 23,079

Note: Enrollment figures are expressed in full-time equivalent units.

TABLE 11

TOTAL UNDERGRADUATE ENROLLMENT AT MEMBER INSTITUTIONS
OF THE DELAWARE HIGHER EDUCATIONAL AID ADVISORY COMMISSION:
AVERAGE 1969-1971 AND SERIES C PROJECTIONS, 1975, 1980, 1985, AND 1990

<u>Institution</u>	<u>Average 1969-1971</u>	<u>1975</u>	<u>1980</u>	<u>1985</u>	<u>1990</u>
Delaware State College	1,443	2,048	2,571	2,639	2,559
Delaware Technical and Community College (N)	926	1,626	2,454	2,965	3,332
Delaware Technical and Community College (S)	881	1,429	2,032	2,342	2,533
University of Delaware	8,850	12,547	15,727	16,113	15,593
Total Public	12,100	17,650	22,784	24,059	24,017
Brandywine College	1,355	1,815	2,139	2,043	1,825
Goldey Beacom College	938	1,259	1,483	1,417	1,266
Wesley College	858	1,151	1,356	1,295	1,157
Wilmington College	434	582	686	655	585
Total Private	3,858	4,807	5,664	5,410	4,833
Grand Total	15,685	22,457	28,448	29,469	28,850

Note: Enrollment figures are expressed in full-time equivalent units.

TABLE 12

RESIDENT AND TOTAL UNDERGRADUATE ENROLLMENT AT MEMBER INSTITUTIONS
OF THE DELAWARE HIGHER EDUCATIONAL AID ADVISORY COMMISSION:
1969, 1970, AND 1971

<u>Institution</u>	<u>Resident</u>			<u>Total</u>		
	<u>1969</u>	<u>1970</u>	<u>1971</u>	<u>1969</u>	<u>1970</u>	<u>1971</u>
Delaware State College	762	1,025	1,234	1,161	1,446	1,723
Delaware Technical and Community College (N)	637	863	1,156	664	920	1,196
Delaware Technical and Community College (S)	700	704	1,036	739	778	1,126
University of Delaware	5,366	6,226	7,319	7,858	8,770	9,922
Total Public	7,465	8,818	10,745	10,422	11,914	13,967
Brandywine College	395	328	276	1,350	1,407	1,307
Goldey Beacom College	350	306	311	1,052	933	830
Wesley College	201	229	224	738	962	875
Wilmington College	78	147	239	323	453	526
Total Private	1,024	1,010	1,050	3,463	3,755	3,538
Grand Total	8,489	9,828	11,795	13,885	15,669	17,505

Note: Enrollment figures are expressed in full-time equivalent units.

Source: University of Delaware, Division of Technical Services, Delaware Higher Education Survey 1972, A report prepared for the State of Delaware Higher Educational Aid Advisory Commission (Newark, Delaware: July 1972), Table II, p. 19.